

REMARKS

Claims 1, 47, 55, and 65 have been amended. Claims 1-47, 55, and 65 are pending in the case. Further examination and reconsideration of pending claims 1-47, 55, and 65 are hereby respectfully requested.

Section 102 Rejections:

Claims 1-3, 5, 8-29, and 41-47 were rejected under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent No. 6,011,404 to Ma et al. (hereinafter "Ma"). Claims 47 and 65 were rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 5,773,989 to Edelman et al. (hereinafter "Edelman"). As will be set forth in more detail below, the § 102 rejections of claims 1-3, 5, 8-29, 41-47, and 65 are respectfully traversed.

A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. *Verdegaal Bros. V. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987), MPEP § 2131. The cited art does not disclose all limitations of the currently pending claims, some distinctive limitations of which are set forth in more detail below.

The cited art does not teach subsequent to annealing a semiconductor substrate, measuring a tunneling voltage of a dielectric material disposed upon the semiconductor substrate and determining a characteristic of metal contamination in the dielectric material, which is a function of the measured tunneling voltage. Amended independent claim 1 recites in part: "[a] method for detecting metal contamination in a dielectric material disposed upon a semiconductor substrate, comprising: annealing the semiconductor substrate,...subsequent to said annealing, measuring a tunneling voltage of the dielectric material, and determining a characteristic of the metal contamination in the dielectric material, wherein the characteristic is a function of the measured tunneling voltage." Support for the amendments to claim 1 can be found in the Specification, for example, on page 16, lines 23-26. Amended independent claim 47 recites similar limitations. Support for the amendments to claim 47 can be found in the Specification, for example, on page 18, line 24 - page 19, line 18.

Ma discloses a system and a method for determining near surface lifetimes and the tunneling field of a dielectric in a semiconductor. Ma, however, does not disclose subsequent to annealing a

semiconductor substrate, measuring a tunneling voltage of a dielectric material disposed upon the semiconductor substrate and determining a characteristic of metal contamination in the dielectric material, which is a function of the measured tunneling voltage. For example, Ma states that “heat cycles are performed that are similar to conventional bias temperature stress measurements (200-250° C.). The surface voltage drop that occurs during a heat cycle is directly proportional to the amount of mobile charge in the oxide.” (Ma -- col. 6, lines 39-43.) Therefore, Ma discloses using heat cycles in combination with surface voltage measurements to determine mobile charge in an oxide. However, Ma does not disclose that a tunneling voltage of the oxide is measured after the heat cycles.

In addition, Ma states that “Valuable information can also be gained by analyzing the high-field tunneling behavior of oxides....Bulk oxide impurities can lower E_{tun} by introducing hopping conduction paths in the oxide. This technique was used to successfully detect low-breakdown samples.” (Ma -- col. 10, lines 53-66.) Therefore, Ma discloses measuring tunneling voltage of an oxide. However, although Ma discloses using heat cycles for other measurements, Ma does not disclose annealing a semiconductor substrate prior to measuring the tunneling voltage. In addition, Ma discloses that bulk oxide impurities can have an effect on the tunneling field. However, Ma does not disclose determining a characteristic of metal contamination in a dielectric material as a function of the measured tunneling voltage. Therefore, Ma does not teach all limitations of claims 1 and 47.

Edelman discloses measurement of the mobile ion concentration in the oxide layer of a semiconductor wafer. However, Edelman does not disclose subsequent to annealing a semiconductor substrate, measuring a tunneling voltage of a dielectric material disposed upon the semiconductor substrate and determining a characteristic of metal contamination in the dielectric material, which is a function of the measured tunneling voltage. For example, Edelman states that “The contact potential shift before and after annealing is determined. The mobile ion concentration within the oxide layer is then determined from this shift.” (Edelman -- col. 1, lines 63-65.) Therefore, Edelman discloses that mobile ion concentration in the oxide layer can be determined from a shift in contact potential. However, Edelman does not disclose measuring a tunneling voltage of the oxide layer. As such, Edelman cannot teach measuring a tunneling voltage of the oxide layer subsequent to annealing a semiconductor substrate or determining metal contamination of the oxide layer as a function of tunneling voltage. Consequently, Edelman does not teach all limitations of claims 1 and 47.

Therefore, neither Ma nor Edelman teach subsequent to annealing a semiconductor substrate, measuring a tunneling voltage of a dielectric material disposed upon the semiconductor substrate and determining a characteristic of metal contamination in the dielectric material, which is a function of the measured tunneling voltage, as recited in claims 1 and 47. As a result, neither Ma nor Edelman teach all limitations of claims 1 and 47.

For at least the aforementioned reasons, claims 1 and 47 are not anticipated by the cited art. Therefore, claim 2-3, 5, 8-29, and 41-46, which depend from claim 1, are also not anticipated by the cited art for at least the same reasons. Accordingly, removal of the § 102 rejection of claims 1-3, 5, 8-29, and 41-47 is respectfully requested.

Claim 65 has been amended to include the allowed subject matter from claim 37; therefore, rejection of claim 65 is hereby rendered moot.

In light of the form amendments to claim 65, which now contains allowable subject matter, Applicant respectfully requests removal of the § 102 rejections of claim 65.

Section 103(a) Rejections:

Claims 1-6, 8-35, 41-47, and 55 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,569,691 to Jastrzebski et al. (hereinafter "Jastrzebski.") in view of Ma. Claim 7 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Ma in view of Edelman. Claim 36 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Jastrzebski in view of Ma and further in view of Edelman. As will be set forth in more detail below, the §103(a) rejections of claims 1-36, 41-47, and 55 are respectfully traversed.

The cited art does not teach or suggest subsequent to annealing a semiconductor substrate, measuring a tunneling voltage of a dielectric material disposed upon the semiconductor substrate and determining a characteristic of metal contamination in the dielectric material, which is a function of the measured tunneling voltage, as recited in claims 1 and 47. As set forth in more detail above, neither Ma nor Edelman teach all limitations of claims 1 and 47. In addition, the combination of Ma and Edelman do not teach all limitations of claims 1 and 47. For example, neither Ma nor Edelman teach measuring a tunneling voltage of a dielectric material disposed upon a semiconductor substrate

subsequent to annealing the semiconductor substrate. In addition, neither Ma nor Edelman teach determining a characteristic of metal contamination in the dielectric material, which is a function of the measured tunneling voltage. Therefore, Ma and Edelman, either individually or in combination, do not teach all limitations of claims 1 and 47.

Amended independent claim 55 recites similar limitations. Therefore, Ma and Edelman, individually or in combination, do not teach all limitations of claim 55.

In addition, neither Ma nor Edelman suggest or provide motivation for all limitations of claims 1, 47, and 55. For example, neither Ma nor Edelman suggest the desirability of measuring a tunneling voltage of a dielectric material subsequent to annealing a semiconductor substrate upon which the dielectric material is disposed. The mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination. *In re Mills*, 916 F.2d 680, 16 USPQ2d 1430 (Fed. Cir. 1990). MPEP 2143.01. Therefore, even if Ma or Edelman could be combined or modified to teach the limitations of the present claims, the resultant combinations or modifications are not obvious since the prior art does not suggest the desirability of such combinations or modifications.

In addition, Jastrzebski cannot be combined with Ma and/or Edelman to overcome the deficiencies therein. For example, Jastrzebski discloses measurement of different mobile ion concentrations in the oxide layer of a semiconductor wafer. Jastrzebski states that "This invention relates to a non-contact, non-destructive method to determine different mobile ion concentrations directly from a change in the contact potential value caused by differential mobile ion redistribution toward or away from the top of the oxide surface." (Jastrzebski -- col. 1, lines 42-46.) The differential mobile ion redistribution is caused by, for example, "heating the semiconductor wafer and oxide layer to a first temperature sufficient to force substantially all of the first mobile ions to migrate across the oxide layer." (Jastrzebski -- col. 2, lines 41-44.) As such, like Edelman, Jastrzebski teaches determining mobile ion concentration from a change in contact potential values caused by heating of the substrate. However, Jastrzebski does not disclose measuring a tunneling voltage of the oxide layer subsequent to heating or annealing. In addition, Jastrzebski does not disclose determining a characteristic of metal contamination of the oxide layer as a function of tunneling voltage. Consequently, Jastrzebski does not teach all limitations of claims 1, 47, and 55.

Therefore, none of the cited art, either individually or in any combination thereof, teaches, suggests, or provides motivation for subsequent to annealing a semiconductor substrate, measuring a tunneling voltage of a dielectric material disposed upon the semiconductor substrate and determining a characteristic of metal contamination in the dielectric material, which is a function of the measured tunneling voltage, as recited in claims 1, 47, and 55. Consequently, the cited art does not teach, suggest, or provide motivation for all limitations of claims 1, 47, and 55.

For at least the reasons stated above, claims 1, 47, and 55 are patentably distinct over the cited art. Therefore, claims 2-36 and 41-46, which depend from claim 1, are also patentably distinct over the cited art for at least the same reasons. Accordingly, removal of the § 103(a) rejections of claims 1-36, 41-47, and 55 is respectfully requested.

Lack of Support for Rejection:

Claim 40 was rejected in the Office Action Summary. However, the Examiner failed to establish a basis for the rejection. Claim 40 depends from claim 38, which the Examiner has recognized as containing allowable subject matter. Therefore, claim 40 is allowable for at least the same reasons as claim 38. As such, allowance of claim 40 is respectfully requested.

Allowable Subject Matter:

Claims 37-39 were objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. Applicant sincerely appreciates the Examiner's recognition of the patentable subject matter recited in claims 37-39.

CONCLUSION

This response constitutes a complete response to all issues raised in the Office Action mailed June 5, 2003. In addition, the art cited but not relied upon is not believed to be pertinent to the patentability of the present claims. In view of the remarks traversing rejections presented therein, Applicants assert that pending claims 1-47, 55, and 65 are in condition for allowance. If the Examiner has any questions, comments, or suggestions, the undersigned earnestly requests a telephone conference.

The Commissioner is authorized to charge any required fees or credit any overpayment to Conley Rose, P.C. Deposit Account No. 03-2769/5589-00501.

Respectfully submitted,



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